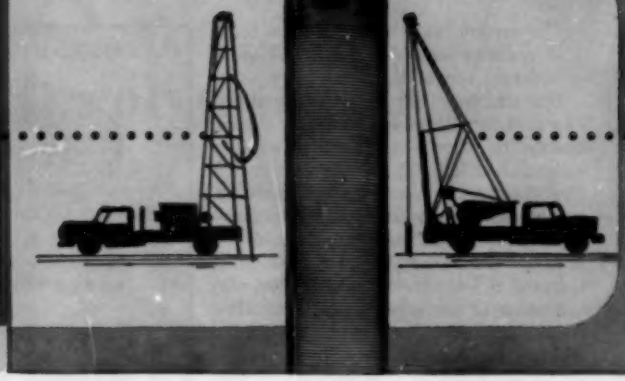
The Johnson National DRILLERS JOURNAL



Vol. 27, No. 6 *The Johnson National Driller's Journal* *November-December, 1955*

Screen Slot Openings Must Be Right

Methods of Testing Sand Samples

No matter how good a driller's workmanship may be in drilling and completing a screened well, he cannot get top-notch results with a poorly designed well screen. It is of utmost importance that the screen be made with the right size, or sizes, of slot openings to fit the grading of the sand or sand-gravel composing the water-bearing formation. This is just as essential as the other basic well-screen characteristics of continuous slots to provide maximum inlet area, non-clogging V openings and welded construction.

The manufacture of a screen with proper slot openings can only be carried out after the following three steps have been taken:

a. Accurate sampling of the water-bearing strata.
b. Careful analysis of the sand samples by standard methods.
c. Selection of slot openings (or gravel-pack grading) from the sand analyses.

The driller plays the most important part in the sequence — the correct results can only be obtained when he takes samples that are fully representative of the materials penetrated by the drill hole. Careless sampling is worse than worthless because it can be seriously misleading. Much remains to be done to develop better methods of taking samples, and it may be fairly said that well construction can be improved only to about the same extent that better sampling may be practiced.

This article, however, is concerned primarily with the second step — the proper methods of testing sand samples. The procedure but not the [illegible] material that contains little or no silt and clay. Methods of washing samples to remove silt and clay and to determine the proportions of these finer materials, will be described in another article.

The equipment required for testing sand samples includes a set of standard sieves, an accurate balance or scales for weighing and a small hot plate. Eight-inch diameter wire-mesh sieves are normally employed. The best type of balance weighs in grams and is sensitive to about one gram. Scales weighing in ounces may be used but they are usually less accurate.

Preparing Sample for Test

Thoroughly mix the original sample. If the material is moist so that the fine and coarse particles remain mixed and do not separate, simply use a small scoop to take out the proper quantity. For the sieve analysis, a cup of material is about the right quantity normally. However, if the material is fine sand, a smaller sample of about one-half cup should be used so that the fine-mesh sieves will not be overloaded.

If the sample is dry, the fine and coarse particles will not remain mixed but will tend to separate or segregate. The dry sample must be cut down by the "quartering" method, so that the reduced sample to be placed in the sieve will contain the same proportions of each size of particle as the original larger sample. Quartering is described as follows and illustrated in the drawing on page 2:

a. Pour the well-mixed sample in a cone-shaped pile on a large flat surface.
b. Flatten the pile and spread the material in a circle to a large "pancake."
c. Divide the flat circular pile in half.
d. Divide each of the two halves of the flat pile in quarters.
e. Remove two opposite quarters and mix the remaining two

Merry Christmas

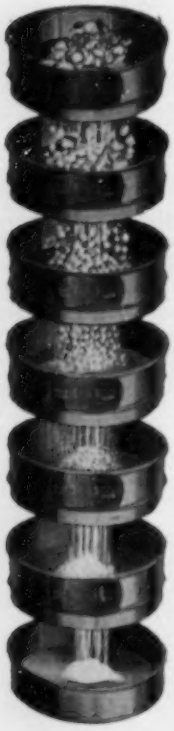
quarters together. This is the reduced sample. (If it is still too large, repeat the quartering.)

Use whatever dry weight of material you find in the reduced sample. Do not attempt to prepare a sample of an even weight, such as 200, 300 or 500 grams. Use about a cup of coarse sand or sand-gravel and somewhat less of fine sand.

If the reduced sample is wet, dry it over low heat, stirring frequently. As the material dries, note whether or not clay causes sand particles to stick together. Any clods that form must be broken down to separate all the particles.

Weighing and Sieving

Select four to six sieves with a series of openings that will separate the sample into various sizes. The coarsest sieve should not retain more than 20 per cent of the sample. The following are suggested groups of sieves:



FOR FINE SAND	
.023″	(28-mesh)
.016″	(35-mesh)
.012″	(48-mesh)
.008″	(65-mesh)
.006″	(100-mesh)
Bottom pan	

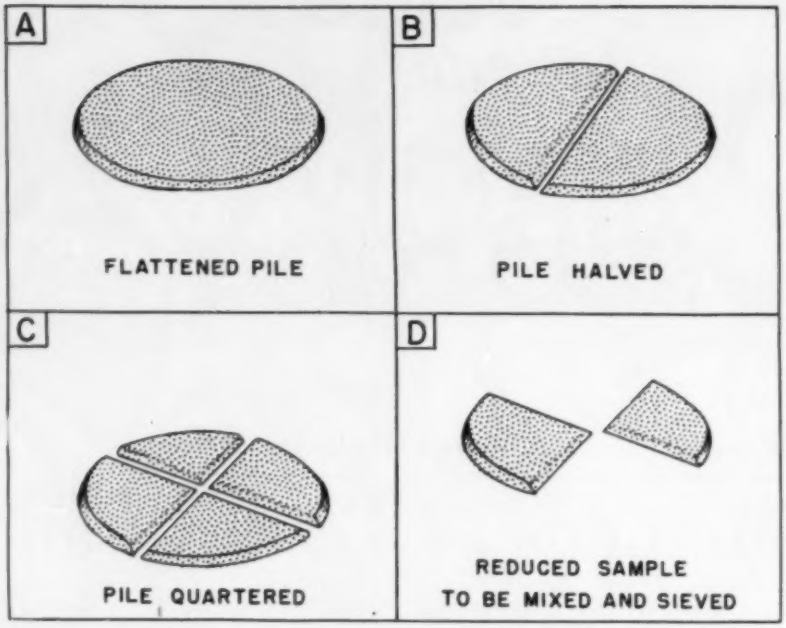
FOR COARSE SAND	
.046″	(14-mesh)
.033″	(20-mesh)
.023″	(28-mesh)
.016″	(35-mesh)
.012″	(48-mesh)
.008″	(65-mesh)
Bottom pan	

SAND AND GRAVEL	
.131″	(6-mesh)
.093″	(8-mesh)
.065″	(10-mesh)
.046″	(14-mesh)
.033″	(20-mesh)
.023″	(28-mesh)
.016″	(35-mesh)
.012″	(48-mesh)
Bottom pan	

Note that the above lists show both the actual size of openings of each screen and the mesh number of the sieve.

Nest the sieves with the finest one resting on the bottom pan and the coarsest one at the top of the series. Weigh the dried sample, record this weight, and pour the sample of sand on the top sieve.

Shake the whole set of sieves with a circular motion and some up-and-down movement, accompanied by a jarring action to keep the material moving over the surface of each sieve. A slight jarring action will vibrate the screen wire in the sieves and will keep them from clogging. When using hand sieving, each sieve may be shaken by itself in addition to shaking the whole set. Mechanical shaking should be employed, if possible.



Empty the material retained by the top sieve into a pan or on a large sheet of paper. Then transfer this material to the weighing pan on the balance and weigh it. Record this weight against the size of screen openings on which the material was retained.

Empty the portion of the sample retained on the second sieve, and add it to the material already in the weighing pan on the balance. Record the combined weight. Empty each sieve successively and record the weight of the accumulated amount in each case. Finally, add the finest material from the bottom pan and weigh. This weight should check the original weight of the sample within two or three grams.

A sample record of the accumulated weight of material on a series of sieves looks like this:

SIZE OF SIEVE OPENING	CUMULATIVE WEIGHTS RETAINED	CUMULATIVE PER CENT RETAINED
.046″	65 grams	17%
.033″	106 grams	28%
.023″	179 grams	47%
.016″	266 grams	70%
.012″	312 grams	82%
.008″	357 grams	94%
Pan	380 grams	100%
Original wgt.	382 grams	

This data is then ready for plotting on suitable graph paper. Plot per cent retained on the vertical scale against the sieve opening in thousandths of an inch on the horizontal scale. Connect the plotted points with a smooth curve.

The "effective size" of the sand is the particle size where 90 per cent of the sample is coarser and 10 per cent is finer. It is the sand size where the curve crosses the horizontal line on the graph paper that represents 90 per cent retained. The effective size was first defined in this way by an engineer by the name of Hazen, who studied extensively the permeability and grading of filter sands. For uniform sands, Hazen showed that the permeability was closely related to the effective size.

(The sand-analysis curve will be discussed in the next issue of the JOURNAL.)

Correction

The two fractions in the sample calculations at the top of page five of the September-October issue of the *Journal* were mistakenly inverted. They should read as follows:

"If 100 gpm is 35 per cent relative yield, then 64 per cent relative yield is 64/35 x 100=183 gpm."

"If 100 gpm is 24 per cent relative yield, then 46 per cent relative yield is 46/24 x 100=191 gpm."

Please make the corrections in your copy of the last issue.

Results Are Hard to Predict

Shooting Rock Wells Involves Risks

Explosives are employed to shoot rock wells as a means of trying to develop greater capacity in a new well or to recover lost capacity in an old well. The practice has shown good results in a fair percentage of cases. However, because of the many unknown factors involved, there is no way to tell in advance if the shooting operation will produce beneficial results.

Water wells are drilled into rock formations, often called solid or consolidated formations, to obtain water in areas where suitable sand and gravel aquifers do not exist. The soil and other loose material overlying the rock aquifer is cased off by driving or setting pipe through it from the surface down to the rock. With this casing seated in the top of the rock, an open uncased hole is drilled through the consolidated formation to the desired depth.

The diameter of the open hole in the rock is usually about the same as the inside diameter of the casing. The drilling bit must be small enough to pass through this casing. The depth of hole in the rock depends upon the thickness of the formation, the quantity of water desired and the water yielding ability of the formation at the particular spot where the drilling is being done. The diameter of the open hole can be enlarged in some rock formations, notably sandstone, by underreaming with drilling tools specially made for this operation. The size of the hole in the rock may also be enlarged by blasting. To do this, suitable charges of explosives are lowered in the well and detonated at the desired depths. Before going into the reasons for shooting rock wells and the methods used, let us briefly review the common types of rock aquifers and their water-bearing properties.

Kinds of Rock Aquifers

Sandstone is a fine to coarse sand which has been cemented together by lime or silica. The cementation obstructs a good portion of the pores so that the sandstone is usually not as good a producer as the same sand in unconsolidated or loose condition. When cementation by silica has been thorough, the pore space is so reduced that the rock is practically impermeable. Such rocks are called quartzites, and are hard and brittle. Although they have low porosity they may have extensive joint systems.

Limestones are productive in some places and yield little or no water in others. Their water-bearing properties depend on variations in size and number of solution cavities, joints and bedding planes. Test drilling is advisable in locating limestone wells, for any one hole may miss all the water-bearing channels entirely. Dolomite, which is limestone containing magnesium, is a good water producer if it contains solution cavities. Chalk, which is a soft, fine-grained limestone, is a good aquifer if it contains many joints and bedding planes.

Basalt is a dark-colored, lava-flow rock and constitutes important aquifers in many areas, particularly in the Pacific Northwest. Ground water in basalts occurs in large joints, tunnels and zones of spongy rock between the individual lava-flow sheets. Not all basalt formations furnish abundant water, but they are always worth investigating.

In granite, water occurs in small spaces of the weathered part of the rock at shallow depths and in joints in the solid materials somewhat deeper. Where granite is covered by overburden there is a gradual gradation from decayed and disintegrated rock at the surface of the granite to fresh rock 100 feet or more below. Wells drilled in granite vary greatly in their individual yields because water is obtained from joints and the penetration of numerous joint openings by any one well is largely a chance occurence. Sometimes the success of such wells may be increased by locating them with reference to the joint systems observed in nearby outcrops. In general, this rock is a poor water yielding material. Gneiss and schist have about the same water-bearing properties as granite. Their joint systems are very poorly developed so most of their water occurs in weathered material near the top of the formation.

Well at Grand Rapids, Michigan, shot with over 100 quarts of nitroglycerin by C. S. Raymer, drilling contractor.

Large Diameter Best

The yield of a rock well depends largely on the number of fissures, crevices, fractures or joints that are encountered by the bore hole as the well is drilled. Obviously, it also depends upon the size of the openings that may be connected to the open drill hole. Since the degree of success is to a great extent a chance occurrence, the larger the diameter the more chance there is of encountering more openings that yield water freely.

Blasting the hole after drilling is completed may enlarge it and shatter the wall to the extent that more of the natural fissures or joints may communicate with the open hole and thus feed water to the well. However, there is much evidence that extended fractures in the formation are unlikely to be formed by shooting. In many cases shooting has been unable to break through between two wells close together. In a specific case, two sandstone wells in Pennsylvania were drilled 40 feet apart to exactly the same depth. Both wells were shot, one repeatedly. One of these wells was a producer, but the other was never anything but a dry hole.

Since the yield from sandstone formations depends upon the porosity of the material rather than joints or fissures, the main advantage in shooting a sandstone well is to increase the diameter of the bore hole. Clearly, the best results will be obtained if the shooting is done at those depths where the sandstone is the most porous.

Another reason for blasting rock wells is to try to recover lost capacity in old wells. Rock wells are subject to in-

crustation, that is, clogging of the formation openings near the well. The accumulation of the incrusting materials depends upon the mineral character of the water and the drawdown. The drawdown, which represents a drop in pressure in the vicinity of the well, permits carbon dioxide to be liberated from the water. This upsets the solubility equilibrium in the water and results in a small but accumulating deposit of calcium carbonate or iron oxide deposits on the wall of the well bore. Iron bacteria or other slime-forming organisms may also cause plugging of the pores in the rock formation around the well or in the crevices and joints. Shooting the hole at the depths where the greatest flow of water into the well normally occurs will shatter the wall of the hole and should remove the clogging materials.

A third use of explosives in rock wells is to try to stop sand-pumping of a sandstone well. Some sandstones are so weakly cemented that some of the material constantly crumbles off the wall of the hole as the well is being pumped. In some cases, shooting will knock down all of the looser material leaving only the more solid sandstone exposed in the well. The percentage of cases where the shooting completely solves the sand-pumping problem, however, is rather low.

Methods of Shooting

Two methods of shooting can be used. One method employs dynamite or nitroglycerin in fairly large individual charges. The other method employs small, shaped charges of TNT.

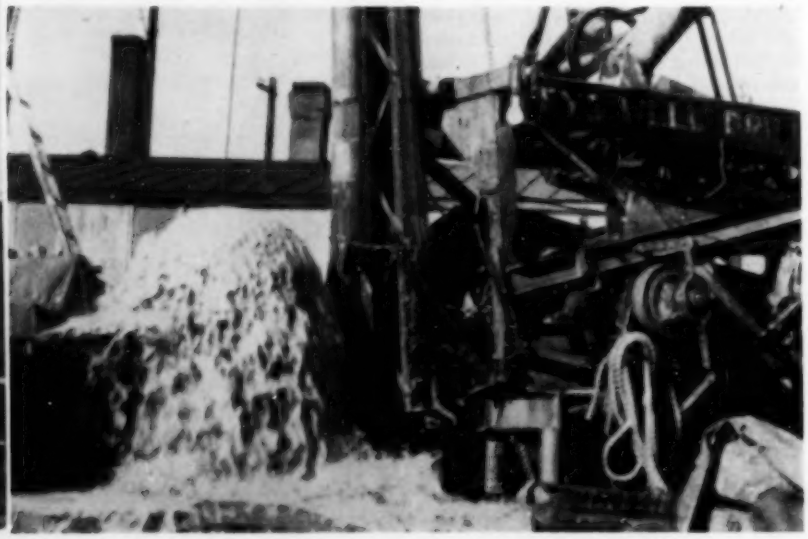
Dynamite seems to be the preferred explosive for shooting water wells. Nitroglycerin is used to some extent in oil wells. Dynamite is less hazardous and more easily handled, however. Some drillers prefer 80 to 100 per cent gelatin dynamite for initial shots, others use 60 per cent dynamite for all shooting. The majority seem to prefer the 60 per cent explosive.

Charges of 100 to 500 pounds are generally used, the size varying with the hardness of the rock to be broken and the depth at which the charge is to be detonated. Since the water pressure increases with depth, heavier charges must be used at the greater depths to overcome the confining effect of the greater water pressure. There is considerable difference of opinion as to the relative effectiveness of different sizes of shots. Some drillers contend that it never does any good to use less than 200 pounds in a single shot. Others say that a succession of lighter shots will give better results on the average.

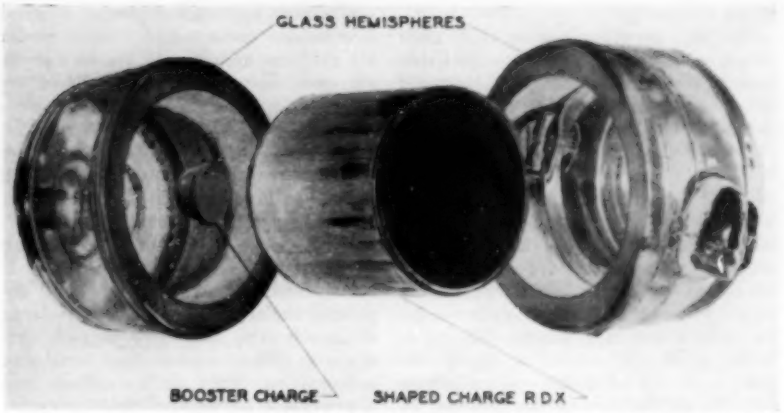
The dynamite sticks, to make up each charge, are put in a water-tight container. A cap and fuse are installed with the explosive and a pair of wires are attached for connecting to the electric detonator after the shot has been lowered to the proper depth. Cast-iron pipe, with the ends attached so they will be water-tight, is the best container for the explosive, according to the Keys Well Drilling Company of St. Paul, Minnesota. Cast iron, being a brittle metal, is completely shattered by the explosive and creates no problem in removing the remains of the container when the well is cleaned out following the shooting. Other types of metal which break up in torn fragments sometimes cause a great deal of difficulty in the clean-out work.

Each individual shot should be detonated opposite a productive zone of the formation. The proper positioning of the shot, therefore, requires an accurate knowledge of the depths of the best water-producing zones that are exposed in the well. Because of this, an accurate log and complete familiarity with the formations in each locality are "musts" for successful shooting of rock wells.

The shaped charges sometimes used are small blocks of high explosive with a cone shaped indentation at one end. They are similar to the shaped charges used in the bazooka weapon for penetrating heavy tank armor. These small charges do not so much shatter the wall of the hole and enlarge its diameter as they penetrate in a horizontal direction into the rock outside the bore hole. A whole series of horizontal channels 10 to 20 inches deep are created by the



Well at Rice Lake, Minnesota, shot with two 100-pound charges of dynamite by Keys Well Company of St. Paul. Picture at left was taken a second or two after detonation. View below shows well continuing to "boil over" minutes later.



Component parts of shaped charge. Watertight glass container keeps explosive dry until shot is fired.

multiple shot.

Since each charge produces only one horizontal penetration, a group of charges must be lowered in the well on a special cage with the individual shots spaced a few inches apart, and directed at various angles so as to cover the entire circumference of the hole. A light aluminum frame is commonly used to hold the series of shaped charges at the proper spacings and directionally disposed as desired. A string of primacord connects all the individual charges and is connected, in turn, to an electric cap at the top of the carrying cage. The primacord is then fired electrically from the surface and its detonation sets off all of the shaped charges simultaneously. In shooting a well at Crystal Lake, Illinois, the charges were set at 6-inch intervals in the carrier. Each charge was directed at an angle of 120 degrees from the next one. In all, 300 charges, each weighing seven ounces, were detonated to shoot a section of sandstone 150 feet thick.

After shooting this well it was treated with hydrochloric acid. The combination of the blasting and the acid treatment brought the well from a reduced capacity of 80 gpm up to 520 gpm, with 109-feet drawdown, or a specific gravity of 4.9 gpm per foot.

Results Obtained

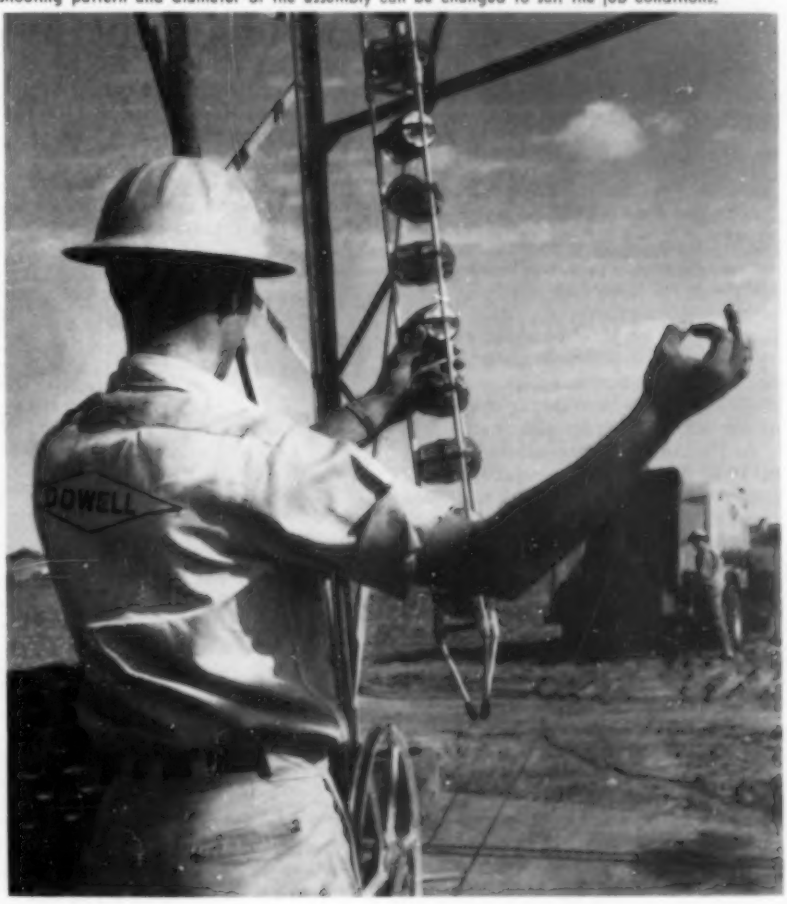
A sandstone well at Elgin, Illinois, when completed, had a specific capacity of 7.8 gpm per foot of drawdown. Six years later the specific capacity of this well had reduced to 5.8 gpm per foot of drawdown. This well was shot with dynamite and 11 cubic yards of sandstone were bailed out after the shooting. The well was then tested and found to have a specific capacity of 8.3 gpm per foot of drawdown.

A limerock well in Wisconsin drilled in 1935 lost almost its entire capacity after 14 years of operation. A total of 98 shaped charges were detonated. The charges were spaced so that the entire open hole through the limerock was shot. After cleaning out, the well was tested and found to have a specific capacity of 4.5 gpm per foot of drawdown, which is about the same yield as when the well was first drilled.

Three city wells at Lansing, Michigan, several years old, were tested and found to have an average specific capacity of 2.4 gpm per foot of drawdown. After shooting with relatively light shots of dynamite the average specific capacity of the three wells was increased to 6.5 gpm per foot of drawdown. A few years later these same wells had again dropped off in capacity to an average of 2.5 gpm per foot of drawdown. They were blasted a second time with the same procedure as before and the specific capacity was brought back to 4.7 gpm per foot of drawdown. These wells are drilled in sandstone.

At Madison, Wisconsin, sandstone wells have been shot in a number of cases with good success, the increase in specific capacity being generally from 25 to 50 per cent. However, a report on one well which was shot with shaped charges using 300 charges was not en-

String of shaped charges positioned in aluminum cage about to be lowered in a well. The shooting pattern and diameter of the assembly can be changed to suit the job conditions.



tirely satisfactory. The specific capacity before shooting was 17 gpm per foot of drawdown and after shooting it was 16. This same well was later shot with 10 charges of 80 per cent dynamite. Over 200 cubic yards of material were removed from the well and the specific capacity was increased to 22 gpm per foot of drawdown.

In some cases excessive caving is caused by shooting. Experience with a 50-foot thickness of sandstone formation in Ohio, overlaid by shale, resulted in excessive caving and costly bailing operations. After using nitroglycerin shots some wells have required as much as five weeks work for clean-out.

A 100-pound charge of 60 per cent dynamite was used to shoot this 8-inch well at Mansfield, Ohio, by the Saltzgaber Drilling Co. The well is 360 feet deep. Its capacity was increased from 123 gpm to 310 gpm.

At Rockford, Illinois, one well drilled in 1948 had a specific capacity of 17 gpm per foot of drawdown. A few years later this was down to 16.2 gpm per foot of drawdown. Forty-two shaped charges were used and after shooting, the specific capacity dropped to 14.5. Perhaps a greater number of shots would have helped. Another sandstone well at Rockford had a specific capacity of 25 gpm per foot of drawdown when first drilled in 1945. Five years later it had decreased to 16. Shaped charges were used to shoot this well and brought its capacity back to 21.2 gpm per foot of drawdown.

A well at Rice Lake, Minnesota, was shot with two 100-pound charges of 60 per cent dynamite. The yield of the well was increased 40 per cent over its original capacity.

The use of explosives in rock wells seems to be declining. This is probably because less than half the jobs attempted turn out successfully. Also, the work involves a number of risks which the owner or the driller may not wish to undertake.

Care Required

The usual safety precautions must be taken. Explosives and caps must be transported separately. They cannot be left at the well site when the crew is away. Police and fire authorities must be notified and kept informed.

The drilling contractor needs to consider carefully what his responsibilities may be for damage to the well and to neighboring property. He should check with a representative of his insurance company to assure himself that his public liability policy covers the situation. He might also have the well owner check his own insurance coverage.

Several drillers have experienced damage suits brought by property owners living some distance from the well site. Claims for cracked plaster, cracked foundations and cracked window panes are common even though cracks may be old ones. Since it is almost out of the question to check the condition of each structure in the vicinity beforehand, the driller may be faced with a difficult job of proving that the shooting did not cause the damage claimed.

The use of shaped charges should reduce much of the possibility of damage claims since the amount of explosive is small and little concussion is felt at the ground surface. Nevertheless, one large drilling firm in Minnesota suggests that when a well-owner wants a well shot with explosives the driller will do best to provide in his contract that the owner take the responsibility for any property damage claims that may arise.

It is seldom advisable to try to stop caving or sloughing in a sandstone well by shooting. Rehabilitation of a sandstone well to stop sand pumping is best accomplished by installing a properly-designed well screen surrounded by a correctly-graded sand pack.

Screens Can Be Installed Easily

Some drillers, unfamiliar with the practical methods of setting well screens, think of the job of installing a screen as something to be avoided. Others who often drill wells in sand or sand-gravel formations look upon the well screen installation as a routine operation.

Telescope sizes of well screens were developed originally to make it easy to set screens in wells drilled by the cable-tool method. As the term "telescope-size" implies, the screen is made just the right diameter to telescope through standard pipe of the corresponding size. For example, a 6-inch telescope-size screen is just the right diameter to pass through 6-inch standard pipe. Enough clearance is provided to prevent getting the screen stuck, while at the same time keeping the diameter as large as possible.

"So, I got a swell new sled for Christmas — and what happens? We're going to Florida for the winter!"

The top of the well screen is normally provided with a lead packer. After the screen has been installed, this packer is flared out to make a sand-tight seal between the top of the screen and the inside of the well casing. A simple tool — called a swedge block and bar — is used to expand the packer inside the casing.

A heavy plate, with a bail handle that goes inside the screen, is normally provided to close the bottom of the screen. The screen is suspended by the bail handle for lowering it in the well, using a flat hook attached to the sand line to engage the bail. Sometimes a string of small-diameter pipe with a hook attached is employed for handling the screen.

Pull-Back Method

The pull-back method is the simplest and best way to set well screens, regardless of the method of drilling employed. The main requirement for making a successful installation is to use casing of such kind, condition and strength that it can be sunk down to the full depth of the well and then pulled back the length of the screen after the screen has been

lowered to bottom. Except in formations which exert an excessive grip on the casing, the use of ordinary practices for preventing excessive friction on the casing will eliminate any difficulties in pulling back.

After the casing has been sunk to the depth at which the bottom of the screen is to be set, the bailer should be used to remove any sand which may have worked up into the casing. If there is difficulty in keeping the sand from heaving inside the casing, this can usually be overcome by adding water to keep the water level in the pipe above the static level in the water-bearing formation. Using a small bailer and running it slowly to prevent producing any suction at the bottom of the well also helps.

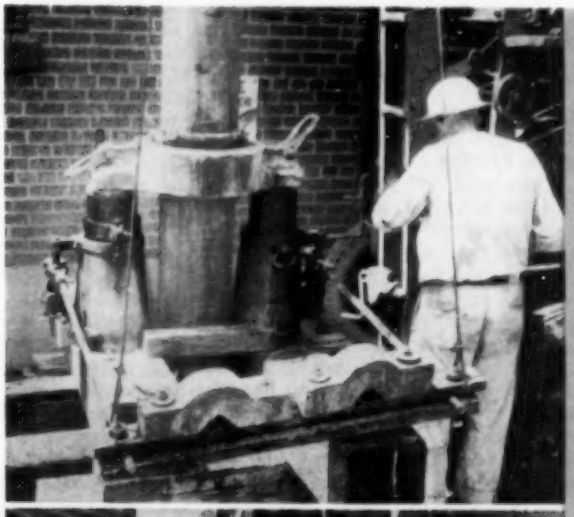
The screen is then lowered inside the casing to the bottom of the well. If the screen is longer than 15 feet and made in two or more sections, the bottom section is first lifted by a rope hitch and suspended inside the casing with a pair of clamps attached near the top of the screen section until the next section is lifted and screwed to it. After the screen is completely assembled, the hook is then caught in the bail handle inside the screen and the screen is lowered to bottom. Careful measurements must be kept so that the driller may know the exact position of the screen at all times.

It is good practice to rest a string of small pipe on the bottom of the screen or lower the drill stem inside the screen to provide extra weight and a means of checking the exact position of the screen as the casing is pulled back.

The casing is then pulled back by any of the several methods commonly used. If the casing has been driven by cable-tool methods, a pulling ring or spider and wedges or slips are used to grip the casing. Either mechanical or hydraulic jacks are commonly used to provide the necessary lifting force. Sometimes the casing can be pulled with the drill line on the cable-tool drilling machine.

When the casing has been pulled back to expose the full length of the screen in the water-bearing sand, final measurements are taken. The lead packer should be from six inches to a foot up inside the bottom of the casing. The packer is then expanded with a swedge block to make a sand-tight seal between the top of the screen and the inside of the casing.

In using the swedge block, two or three lengths of small diameter pipe should be screwed to the bar which slides through the block. The assembly should be lowered in the well until the swedge block rests inside the lead packer. The weight provided by the pipe attached to the bar should then be lifted six or eight inches and dropped several times. The swedge block itself should not be lifted out of the packer, but should simply be forced down into the packer by successive blows of the bar and the weight above it. With the packer tight, the well is then ready for development.



Weights attached to pump handles of two hydraulic jacks to operate the jacks in unison while pulling back 12-inch casing.

Weight is lifted and dropped by using casing line of the drilling machine. Spider and slips are used to grip 12-inch pipe.

Rotary Drilled Wells

The pull-back method of screen installation is also the most practical method to use in rotary drilled wells. After completing the drilling, the casing is set to the bottom of the well and any cuttings that may have settled inside it are carefully cleaned out. The screen is then lowered inside the casing to bottom and the casing pulled back to expose the screen. The principal difference in the method involves holding the casing suspended at the ground surface with spider and slips during the development of the well. Since there is little or no friction on the outside of the pipe, it will not stay in place by itself until the formation has caved around it.

Setting the casing to the bottom of the hole initially may seem to be a little extra work. However, this operation prevents any difficulty from premature caving of the hole—an important consideration.

If the situation requires that the casing be cemented in the hole, the drilling is first carried only to the depth at which the casing is to be set permanently. The casing is run and grouted as required. A bit just large enough to go through the casing is used to drill through the water-bearing formation below the bottom of the casing to permit installation of the well screen. A telescope-size screen is then lowered through the casing into the open hole below, the drilling mud is removed, lead packer expanded and development work started.

Do Water-Conditioning Gadgets Work?

Here are the answers based on the observations of engineers who have conducted rigorous plant tests

(Continued from the September-October issue of the JOURNAL*)*

By B. Q. WELDER *and* EVERETT P. PARTRIDGE

• *At the Fourteenth Annual Water Conference of the Engineers' Society of Western Pennsylvania, in October, 1953, the authors presented first-hand experience accumulated by their field engineers on "gadgets." Their paper subsequently was published in the May, 1954, issue of Industrial and Engineering Chemistry. Slightly condensed, it appears on the following pages.*

In addition to the preceding gadgets, for which the authors have specific case histories, we have received information concerning the following devices but do not as yet have firsthand reports concerning their use.

Gadget I-C. Gadget I-C, apparently developed in Switzerland, invokes ultrasonic vibration to remove scale continually as it is formed. A simple transformer and single tube amplifier with a power consumption of 20 watts supplies up to four oscillators from which damped vibrations of 28,000 cycles per second are transmitted to the feed or boiler water.

Gadget II-F. Gadget II-F is a cylinder said to contain a permanent magnet. As water passes through the cylinder,

"the molecules of salts of calcium, magnesium, silica, and other scale forming substances which have been submitted to the electric bombardment receive a superficial tension which prevents the normal formation of carbonates, sulfates, and silicates, with waters of crystallization. When the carbonates, sulfates, and silicates precipitate they are in the amorphous form as the molecules of water of crystallization are no longer attracted. Maintaining these scale forming salts in the amorphous form, of course, prevents crystal formation and prevention of crystal formation prevents scale formation."

Gadget II-G. Gadget II-G, claimed to have been used in France since 1938, has not even arrived as yet in the United States but quite possibly will be promoted here in a year or two. It comprises an activator, which appears to be a glass tube filled with small particles of mineral. This activator is alleged to emit electromagnetic radiations, not detectable with a Geiger counter.

"Under the effect of these appropriate radiations, without ever causing corrosion of the metal, all alkaline-earth salts held in solution in water, no matter what their composition or concentration may be, become amorphous as soon as they become insoluble and incapable of adhering either to one another or to any given surface."

The activators are suspended in a tank through which the water to be treated flows. However, the tank must be grounded so that the resistance in the ground circuit is less than eight ohms. This is accomplished by means of a cage of copper strips installed in contact with the wall of the tank and linked with a copper ground wire.

Gadgets Don't Help

From our experience, gadgets do not prevent scale and corrosion under the varied conditions met in practice. If there were a way of achieving a consistent record of satisfactory results, then some gadget should have succeeded in establishing itself more generally than any has. Actually, in the more than three quarters of a century since the first objective engineering investigation of the "use of electricity and zinc plates for the prevention of boiler scale" was made by Fischer in 1876, gadgets have come and gone in a motley procession. None of the four investigated by DeBaufre in 1932 appears to be on the market today, although the inventor of one is currently listed as vice president of a company promoting a different gadget.

If we peer behind the often preposterous explanations and claims made by the promoters of gadgets, three interesting scientific phenomena are visible, all concerned only with the precipitation of calcium carbonate. Since no promoter of a gadget has yet mentioned these phenomena, we may assume either ignorance or an intent to mislead. These three phenomena are:

Water which normally should deposit calcium carbonate as a result of moderate heating or chemical treatment has a strong tendency to remain supersaturated.

Precipitation of calcium carbonate from such a supersaturated water may be prevented or greatly retarded under some conditions by very small amounts of a number of substances.

Precipitation of calcium carbonate as separate crystals may be promoted by the addition of some substances which provide nuclei for crystals to start to grow from the supersaturated solution.

An inquiry into the anatomy and composition of a number of gadgets suggests that most of them probably represent attempts to apply one or the other of the two mechanisms described. Unfortunately, the introduction of a little corrosion product, whether it be zinc to try to delay precipitation of calcium carbonate or iron or copper to try to accelerate it, does not solve all of the problems to the extent the promoters wishfully allege. Our own experience indicates that it does not even have a good batting average in keeping down the formation of calcium carbonate scale, the only beneficial result the most hopeful could expect.

Methods of Promotion

In the main, gadgets are actually sold to plants by men of good reputation working for an established local company handling plumbing supplies or small items of plant equipment. In the early stages of a promotion, these salesmen are honestly enthusastic. Later, faced with more and more instances in which a gadget has failed to produce the anticipated results, they may respond with anything from apology to argument. Admittedly, they know only what has been told them by the promoter.

The promoter himself may be an inventor with a stubborn belief that his invention must work; he may, however, be nothing more or less than a sharp operator. The man with a gadget to promote faces an intriguing series of problems. If he is aware of past experience, he realizes that he must make some fast bucks and get out. He can, of course, dissolve a dying venture under one name and start up again with a similar gadget under a new name. He can also shift his campaign from one part of the country to another, keeping one jump ahead of a disappearing reputation. He can even work on a global scale, bringing to eager Americans the gadget which no longer is able to find a market in England or in France.

The promoter has two powerful in-

Mr. Welder and Mr. Partridge, are engineers at, and the latter is director of, Hall Laboratories, Inc., Pittsburgh, Pa.

fluences working for him, social hysteresis and personal pride. He can count on a period of from one to three years before the lag in communication of practical results from plant to plant has pretty well killed off further prospects. This period of hysteresis may be prolonged by the very human reluctance of the person who has been "taken" to admit the fact. Customers who have given testimonials during an early period of enthusiasm are not prone to confess that the gadget actually did not perform over the long haul.

The promoter, faced with the necessity of working fast, naturally avoids as much as possible the man with technical training. Instead, he aims his campaign below the engineer and above him. If he cannot sell the nontechnical operator, perhaps he can intrigue the plant manager or the vice president.

Not every gadget is promoted in the same way. However, the pattern is likely to comprise several of the following elements:

1. It is claimed that the gadget solves any and all problems encountered in the use of water—scale, corrosion, slime, taste, odor.

2. The gadget is alleged to produce many beneficial side effects—it improves growth of vegetation, makes water feel smoother, makes soap act more powerfully even though the hardness of the water is not decreased.

3. The gadget is stated to achieve its remarkable results because of the alleged action in peculiar ways of natural forces, such as electricity, magnetism, catalysis, radiation, ultrasonic vibration, all described in language which sounds scientific but cannot be understood.

4. The gadget requires little or no attention and no chemicals are required.

5. The gadget is represented to be so sure-fire that the initial cost will be refunded if it does not prove satisfactory during a period of 60 or 90 days.

6. Testimonial letters, stated to be unsolicited, are offered to prove that performance has been excellent.

7. Tests under controlled conditions in the laboratory are generally deprecated as not being capable of showing the performance in practice.

8. Advertising or promotion by mail is avoided or is much more conservative in tone than that supplied by direct contact.

Testing a municipal well for Bedford, Massachusetts, at 200 gpm with 14 feet drawdown. The well is equipped with an 8-inch Johnson Well Screen, 6 feet long, with No. 50 slot openings. Haley and Ward of Boston were consulting engineers; Eastern Drilling Co. drilled the well.

What to Do?

What course of action is practical for the man in the plant besieged annually by a new promoter with a new gadget? Some engineers of native intelligence and good training have been known to follow a policy of trying out each device offered to them. Such a solution is perhaps an eminently practical one when the gadget has been recommended to the vice-president by an influential friend over the luncheon table. It does lead immediately to the citation of the company by the promoter as a "satisfied customer." Many a large corporation has been startled to find itself in such a position as a result of having installed — and subsequently discarded — a gadget in some obscure corner of the organization. Another course of action might be to ask for evidence that the practical performance of the gadget in question had been reported objectively by a reputable engineer before some technical society. This is a slow, hard way of building acceptance employed by companies which intend to remain in business indefinitely. If a gadget has achieved a useful result, then let the engineering profession have the opportunity to take a thorough, critical look at all of the pertinent data.

Air Freight Service Has Been Expanded

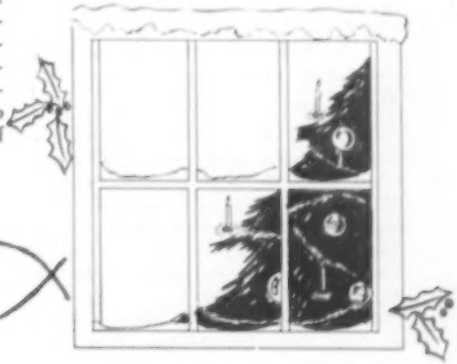
Air freight service from St. Paul, Minnesota, has recently been expanded, making possible efficient air freight shipment of Johnson Well Screens to many additional places. The following are examples of air freight rates.

FROM ST. PAUL TO:	AIR FREIGHT, Per 100 lb.**	RAILWAY EXPRESS, Per 100 lb.
Akron, Ohio	$ 6.90	$ 8.18
Albany, N. Y.	10.30	10.84
Boston, Mass.	11.50	11.32
Buffalo, N. Y.	7.80	8.90
Chicago, Ill.	3.60	6.48
Cleveland, Ohio	6.90	8.18
Detroit, Mich.	5.80	7.69
Hartford, Conn.	11.00	11.08
Kansas City, Mo.*	6.80	6.72
Los Angeles, Cal.	15.30	14.71
Milwaukee, Wis.	3.00	5.80
Newark, N. J.	10.30	10.84
New York, N. Y.	10.30	10.84
Omaha, Nebr.*	5.00	5.80
Pittsburgh, Pa.	8.00	8.90
Portland, Oregon	15.00	13.02
Philadelphia, Pa.	10.10	10.35
Providence, R. I.	11.50	11.32
Rochester, N. Y.	8.10	9.39
San Diego, Cal.	15.40	14.71
Seattle, Wash.	15.00	12.77
South Bend, Ind.	5.50	6.97
Toledo, Ohio	5.80	7.69
Washington, D. C.	9.40	10.11

*Limited in length to 5-ft. sections.
**Airport to airport rate.

Omaha and Kansas City are served by passenger flights *only* which limits the length of screen sections to about five feet. Cargo aircraft service (plus short truck hauls in some cases) is available to the other places listed above with practically no limit on length.

The air freight rates are for shipments weighing over 100 pounds, from airport to airport. Pick-up and delivery charges vary, but are normally 50 cents per 100 pounds at each end, with a minimum charge of $1.15. Express rates include pick-up and delivery.



Merry Christmas

ASSOCIATION NEWS

This section is devoted to the exclusive use of water well drillers' associations, both state and local. Notices, announcements, changes of officers and other items should be sent to The Editor, Johnson National Drillers' Journal, 2304 Long Ave., St. Paul 14, Minnesota.

Illinois

The committee in charge of the 1956 convention for the Illinois Water Well Drillers Association is hard at work organizing the program and other details. The meeting will be held January 25, 26 and 27 at the Pere Marquette Hotel in Peoria.

The facilities for the convention in Peoria are excellent. The location is easily accessible from all parts of the state and a record crowd is expected. Full details of the program will be sent out later by Robert Parks, service secretary. The hotel has ample space for a number of indoor exhibits and outdoor space has been made available adjacent to the hotel for drilling machines or other large equipment.

Mississippi

A good crowd was on hand to attend and enjoy the annual meeting of the Mississippi Water Well Contractors Association at Pass Christian on October 14. The weather was perfect and both the program and the entertainment were conducted out of doors.

At the business meeting, J. C. Reeves of Amory was elected president for the coming year. E. W. Hall of Jackson was elected vice-president and Fred Sutter will continue as secretary. It was decided that the site for the next year's meeting should be voted upon by the entire membership. This will be handled by mail.

The co-operation of the association has been requested by the health department in sterilizing wells by chlorination upon completion and in constructing concrete slabs around the well casing to prevent seepage around the outside of the casing. These precautions are particularly important in many of the shallow wells being drilled.

Michigan

The Michigan Well Drillers Association announces that its 28th annual convention will be held at Lansing on May 17 and 18, 1956. The excellent success of the convention last year at Lansing influenced the Board of Directors to select this city again as the convention site for 1956.

Leo Riegler has been selected as convention chairman and he will appoint the various committees that are to handle the different responsibilities for the meeting.

Nebraska

The 1956 meeting of the Nebraska Well Drillers Association will be held at Lincoln on February 23 and 24. The facilities of the University of Nebraska will again be made available to the association for the exhibits and the technical sessions.

Vincent Dreeszen and the various committees are working out the program and other details of the meeting. More information will appear in the next issue of the *Journal*.

Kansas

The new president of the Kansas Water Well Drillers Association is O. E. Rosencrantz of Great Bend. Other officers include W. L. Hendee, Sr., of Muncie, vice-president; James Strader of Holton, secretary-treasurer and J. M. Jewett of Lawrence, service secretary.

The annual meeting was held at Salina on October 21 and 22. It was well attended by an enthusiastic group of drillers.

The outstanding items on the program included a discussion of the effect of drought on ground water levels in Kansas and the important features of financing irrigation wells by both private and public lending agencies. The banquet was an enjoyable affair at which Dr. W. H. Schoewe of the Kansas Geological Survey was the speaker. The entire convention was well conducted by the officers and the convention committee.

License fees for truck-mounted drilling machines were discussed at the business meeting and the legislative committee was instructed to obtain a uniform ruling that would classify them as construction equipment. In many counties they are now classified as such if they are called "well drilling cranes."

Indiana

Plans are nearing completion for the 1956 convention of the Indiana Well Drilling Contractors Association to be held on January 19 and 20. The meeting will be held in the Van Orman Hotel at Fort Wayne.

The association now has the largest membership in its history. The organization gained much prestige this year when it represented the interests of water well contractors in hearings before the Indiana Legislature on proposed ground water legislation.

The secretary, R. T. Hill, and the committees are working out a fine program for the convention, and there will be a record number of exhibits. Every water well contractor in Indiana should attend this meeting.

Minnesota

The directors of Minnesota Water Well Contractors Association have selected March 22, 23 and 24, 1956, as the dates for the next annual convention of the organization. The exhibits and meetings will be at the Hotel Nicollet in Minneapolis.

Norm Ovrom, executive secretary, is developing the program and other arrangements. More details will be given in the next issue of the *Journal*.

Pennsylvania

Leon Slauch, who is convention committee chairman, announces that the Pennsylvania Water Well Contractors Association will hold its sixth annual convention on April 6 and 7, 1956. The meeting will be at Penn State University at University Park.

The committee is planning an outstanding program of interest to every water well driller in Pennsylvania and neighboring states. Further details will be available later.

Oklahoma

An excellent crowd of members and guests enjoyed the convention of the Oklahoma Water Well Drillers Association held at Enid on October 27 and 28. A record number of exhibits of the latest in equipment and materials were

Christmas

1955

Courtesy Minn. TB and Health Association

This huge, 160-acre Chicago plant of Crane Company started 100 years ago as the little 14' x 24' workshop of R. T. Crane, pictured below. Crane Company now has 14 manufacturing plants in Canada, England and the United States.

Crane Notes Centennial

A century of achievement that parallels American progress in industry and living conditions is being celebrated this year by Crane Company, the world's largest manufacturer of valves, fittings and fabricated piping; and major producer of kitchen, bathroom and heating equipment.

According to Crane's president, Frank F. Elliott, the reason for this parallel growth lies in the fact that Crane products are fundamental to our machine age — an age that takes mechanization for granted and demands more and more of it for daily needs and comfort.

On July 4, 1855, Richard Teller Crane opened the first Crane shop, built by himself, in the bustling little city of Chicago, which then claimed a population of 75,000. His only products at that time were brass couplings and copper tips for lightning rods. Since then a great array of items have been added in the plumbing, heating and industrial piping fields.

In addition to extensive manufacturing facilities, Crane Company has 150 branch houses to distribute its products and related items. Many Crane Company branches are jobbers of Johnson Well Screens.

We take this occasion to wish the Crane Company a second century of progress as successful as its first.

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displayed.

The program included talks on well drillers' responsibilities, pumps, foreign drilling operations, and a panel discussion of well problems. An unusual feature was a frank discussion of what the well owner expects of the well drilling contractor by Tom Wright, president of the Northwest Oklahoma Irrigation Association.

The annual Sooner party, ladies events, banquet and dance made up the social program. Al Braithwaite of Enid was the banquet speaker. New officers of the association for 1956 will be elected at a business meeting to be called in December.

Colorado

This was the big year for exhibits of materials and equipment at the meeting of the Colorado Water Well Contractors Association. The crowd of members and guests who attended the 22nd annual convention in Denver on November 4 and 5 found plenty of displays on hand to suit them.

Interest in the program and business meetings reached a new high. Discussions of license requirements and penalties for non-compliance, membership status and dues of the association, insurance and contract forms were frank and promise to be highly fruitful. All 1956 dues are supposed to be paid by January 15, in accordance with the new scale adopted.

Art Price of Sedalia was elected president for the coming year. He has already appointed some working committees to carry on the association work. Marion Smith of Monte Vista is vice president, Fred Pearson of Englewood continues as secretary-treasurer and Luther Symons is employed as executive secretary.

Washington

A proposed state water policy and means of preventing pollution of ground water supplies were the two main topics discussed at the annual meeting of the Washington State Well Drillers Association on November 4 and 5 in Seattle. A smaller-than-average crowd attended, but the group did not lack for enthusiasm.

It was decided to hold a regional meeting in Vancouver, B. C., some time in March, next year, since the association includes several Canadian members.

At the business meeting, A. G. Kounkel of Stanwood was elected president for the coming year. The new vice-president is W. C. Henderson of Ellensburg. Geo. Zent continues as secretary-treasurer and Mrs. Helen Davis as corresponding secretary. Drilling contractors who did not attend the convention should mail their membership dues to the secretary.

Well, here's the end of another year rolling 'round. It seems like just last week that I was sayin' th' same thing about 1954. I can remember years an' years ago, when I was a kid in school, we were all kind o' noisy an' uneasy just before Christmas. Our old teacher had done a lot o' scolding and a bit of cuffing. (I call her "old" because she seemed awful old to us kids then, an' she was probably 20 years younger than I am now, an' I still don't call myself old.) She finally grabs one of th' boys by the nape of th' neck an' asks him, "what makes you so full of th' wiggles?"

"Well," he says, "I guess it's because it takes so long to get from here to Christmas."

She laughed an' let him loose. Then she said th' thing that made me remember it all — she says, "You'll get over that. I'm sorry to tell you; an' when you get to be my age, time will go so fast you'll never seem to catch up with it."

I remember that I thought she must be crazy. How in th' world could time go so fast for grownups, when all they seemed to do was work while us kids had lots o' time for play? It didn't make sense. But all of us know it's a fact. Th' busier we are an' the harder we work and the older we get, th' faster time goes by.

Avoid Carelessness

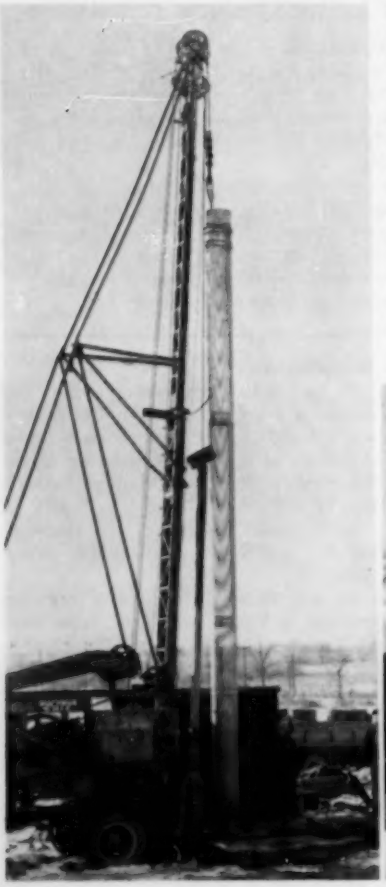
Which brings me up to what I was goin' to tell you about. Maybe you'll remember that two months ago (seems like two weeks) I was tellin' about th' costly mistakes we can get into by being just careless, an' how I nearly got myself into a squeeze by bein' too cocksure of myself. Well, since then I've got another example for you right down th' same line and just a couple of weeks after I got through warning everybody about carelessness.

This is one that sits right in my own lap an' makes me mad at myself. It happened about six weeks ago. We were on a rock well that was running deeper an' harder than we had expected. It was 12-inch for th' first 165 feet. We had set our liners an' were down drilling open hole through sandstone at something over 600 feet. We had run into trouble with sloughing in a sandstone farther up an' so we were one size smaller than we had expected to be at the bottom.

As I said, th' sandstone at th' bottom was drilling much harder in this well than th' same formation usually drills. Our tool weight wasn't enough to make good footage. We've got a stem that was originally used with a bigger string o' tools an' I had put it in th' shop an' had the boys cut down th' joints an' boxes to fit into a smaller string. That gives us a real heavy stem for th' small tools. Th' boys are usually careful about our tool joints, and I claim to be downright fussy. But for some reason or other — carelessness or thoughtlessness, call it what you want to — we slipped up on this one. When I sent it out on this job I just gave it a quick look before it left th' shop. (They were in a hurry, of course.)

You know what happened — I don't need to tell you! Luckily it fished out without much trouble. But even an easy fishing job is a dead loss. When I looked at th' pin I was ashamed of myself and of our shop. Here was a joint that was too light to start with, and if a half-blind man looked carefull he could see where there was a scratch-line that caused th' trouble. But I had missed it by breaking my own rule about being fussy with tool joints. Don't ever forget, men, that a scratch-line at th' base of a pin invites failure. In fact, it's the actual start of a failure. I asked for trouble this time, and I got it in a hurry.

As I said before, these troubles are just as real costs in a well driller's business as th' labor an' material he pays for. And if th' driller doesn't figure them in as part of his costs he'll wake up broke at th' bottom of th' hill sooner or later.



Setting 18-inch Johnson Everdur Screen in well 100 feet deep for City of Plymouth, Michigan. Drilling contractor is Dunbar Drilling and Supply Co. This is a naturally-developed well and upon completion was tested at 3,511 gpm at 26.5 feet drawdown, a rate of 5 million gallons per day.

Now here's something big and important that we must not forget — *costs don't usually set prices, but they do set profits.* It isn't what it costs *you* or *me* to drill wells, an' handle pumps, an' do all of th' rest of th' work we do that sets th' price we get for them. In all but a few cases, it's the free market that sets th' *prices;* and our costs don't do much more than determine what our *profits* are going to be. Even for the industry as a whole, this holds true in a general sort o' way, because if th' price gets too high, th' buying public starts to resist buying wells — they consider other substitutes, such as surface supplies or recirculation or refrigeration, etc.; or they decide not to put in a standby well or a pasture well or a bigger well. Believe me, it works this way, just like it does in all of the industries when we have a a free, democratic system without socialism or monopolies. That's th' system we want an' we're mighty lucky we've got it! This is a kind of pet subject o' mine that I'd like to go into a little more some time later on.

Christmas Spirit

But this is Christmas time. It's th' time o' year when our point o' view on things gets a little less commercial (or it ought to). Takes me back again to th' days when my mother used to get us kids all together on th' Sunday night before Christmas an' tell us th' story of little Gretchen. She told us th' same story for a dozen years while we were growin' up — but it never got old th' way she told it, an' I've never forgot it.

It's a simple little story 'bout a German woodcutter who lived with his frau and three children at th' edge of th' forest. They were poor as church mice, and it was all th' father could do to keep his family in food an' clothes an' shelter.

So when Christmas came along it was real slim picking for presents — just a bit o' candy an' some homemade trinkets. But that didn't mean th' kids couldn't dream about sleds an' toys an' dolls; an' they used to spend hours looking in th' windows of th' stores in th' village whenever their mama would let them go to town.

On Christmas eve she told 'em to run along to look in th' windows; so off they scampered — Hans, th' oldest boy, stretching his long legs an' leavin' Peterkin behind to help his little sister, Gretchen. That's th' way they were, them boys — good youngsters, but Hans always teasing an' Peterkin always being kind.

How beautiful th' windows were! How th' tinsel glistened! How wonderful th' toys an' dolls looked in their pretty colors an' wrappings! An' how little Gretchen squealed with delight when she saw a set o' tiny blue dishes! She had a rag doll an' a box for a dollhouse. What a wonderful time she could have keepin' house with those beautiful doll-dishes.

Make Gretchen Happy

As always, they went home with thrilled hearts an' empty hands. But Peterkin wasn't satisfied. He slipped back to th' village to find out what those blue doll-dishes cost. After all, he had a pfennig an' he would gladly part with it to make Gretchen happy.

His childish hopes were shattered when he found out they cost ten pfennigs. That was a hopelessly big sum o' money for a poor little boy like him. So he used his pfennig to buy a beautiful candy heart which he dropped into Gretchen's stocking after she'd gone to bed.

Later that night, big brother Hans come a-snoopin' 'round, as big 12-year-old fellows will do, an' he came across that candy heart. Hans was always hungry as any 12-year-old is. He took a bite, an' before he knew it th' whole candy heart was gone.

What to do? Hans knew he'd done wrong — an' more than that, he really loved his little sister. He couldn't bear to think that he would spoil her Christmas.

Hans had saved ten pfennigs toward buying a new sled some day. It had taken him all year, an' those ten coins hidden in his bedroom meant a lot to him. But Hans didn't hesitate more'n a minute before he slipped into th' bedroom, and got his treasure, ran to town an' came back with th' little blue dishes for Gretchen's stocking.

What excitement there was next mornin'! Gretchen squealed with joy like they'd never heard before — an' Hans had th' happiest look on his face that a 12-year-old ever wore; but he didn't say a word. Peterkin's eyes were like saucers, too, an' he went around like he was seein' things — which he was! But he, too, didn't say a word — just wondered how such miracles really did take place.

And it was a miracle, too, mother used to tell us, for Hans' greed had been changed into kindness. That's th' biggest miracle of Christmas, from th' manger in Bethlehem, 2,000 years ago, right on to our days — changing cruelty, greed an' selfishness into kindness, generosity and unselfishness.

Doesn't Last Long

Strange how it works, ain't it? Even some of th' meanest ol' goats I ever knew seem to show up with a streak o' kindness 'round Christmas time. The only sad part 'bout it is that it don't last long enough. Seems like too many of us crawl back into the same ol' shell 'round th' middle o' January. We ought to do something about it.

Can't we all try making th' Christmas spirit that burns so bright in December last longer so it's more than just a sputter by th' 4th of July? We can do a good bit toward doing it by makin' more use of our smiles instead of our frowns, even toward our competitors. I've got a sneakin' hunch we'd get along better that way. An' we can be a bit more tolerant with that young salesman who comes 'round to sell us on his line. Could be he's got somethin' worth listening to if we give him a little encouragement.

Then there's th' "home-guard" that hangs 'round our jobs and asks all them dagnabbed foolish questions. A pleasant answer might come back in th' shape of a well job some day — fact is, I've had it happen.

So there we are — back to just you an' me. If we want to, we can do a good bit toward keepin' these things a part of our lives all year. I reckon it's worth a try.

Merry Christmas, Happy New Year!

Tom

Merry Christmas

ADVERTISEMENTS

We will insert advertisements for drilling equipment wanted or for sale, help or work wanted, etc., for our readers, free of charge. Advertisements must be brief, and we cannot assume responsibility for them, but will be glad to put parties in touch with each other by this means and suggest that they investigate any offers or inquiries carefully for themselves.

WANTED: Sales engineer or geologist, with experience in well drilling and turbine pumps, to design and sell wells for municipalities and industry. Salary and profit-sharing. Give all experience and references in first letter. Keys Well Drilling Co., 413 North Lexington Avenue, St. Paul 4, Minnesota.

FOR SALE: Bucyrus-Erie 20-W drill that has drilled only two wells. Has calf reel and spooling device; with or without truck. Also, B-E 22 drill with spooling device, casing reel, power derrick-hoist. Mounted on Reo truck; good condition. Priced to sell. H. A. Butler, P. O. Box 96, Delafield, Wisconsin.

FOR SALE: All-steel jet drilling machine with drill line, tools and equipment. 1947 Ford truck with water tank; 1950 Fork pick-up. New 300-gal. gas tank; some pipe and pipe racks; 12′ x 12′ shed, nearly new; two lots in Hecla. John Lahman, Hecla, South Dakota.

DRILLER WANTED: Drill operator for Bucyrus drill, mostly 6-inch wells. Must have experience on sand and gravel wells. Steady work, with wage and bonus on footage. H. A. Butler, P. O. Box 96, Delafield, Wisconsin. Phone 33.

FOR SALE: Sullivan rotary, 3,000′ capacity, 5 x 8 pump, Diesel power. Winter-Weiss rotary with long mast and long kelly and with compressor. Also, Mayhew 1000 and Failing 1000. Fred E. Butler, Box 481, Pueblo, Colorado.

FOR SALE: Keystone drill with steel frame, self-propelled; Waukesha engine. Cheap. H. A. Butler, P. O. Box 96, Delafield, Wisconsin.

FOR SALE: Armstrong drill, semi-trailer mounted, with 1½ ton Chevrolet truck; 500′ of ¾″ cable, 500′ of ⅞″ sand line, large cathead, and power hoist for mast; complete string of 5″ tools. Has Allis-Chalmers W C engine, recently overhauled; self-starter. Lindsay Bros., 400 North 1st Street, Minneapolis, Minnesota.

FOR SALE: Drilling business; including 20-W Bucyrus-Erie drill, mounted, with 4 sets of cable tools. Also tools for 2″ and 3″ well repair work. Want to retire. Good location. Leonard J. Weber, Fowler, Michigan.

FOR SALE: Failing rotary drill mounted on 1951 Fork truck; complete with drill pipe and tools. Water truck, 1952 Ford with Guffin tank, front-end winch, 2-speed axle, mud tires. A-1 condition. Bargain for water-well, test-hole, shot-hole or core drilling at $5,500. H. V. Hueppelsheuser, 822 East Maple, Enid, Oklahoma. Phone AD 7-2690.

DRILLER WANTED: Cable tool driller, also power auger operator, to work on commission or footage. Give age, experience and qualification in letter. Spitzer Well Co., Tracy, Minnesota.

FOR SALE: Two No. 42 cyclone drills, one 1952 model on 1952 Chevrolet truck, driven only 4,000 miles, and one 1954 model on 1947 Chevrolet truck with new motor. Both machines complete with cable and tools. Good condition. Lee L. Cummings, Route 1, Seymour, Indiana. Phone 3028 W.

FOR SALE: One shop-built rotary drill, all-steel, trailer-mount, 32-ft. mast, 22-ft. kelly bar, 2⅝″ drill pipe, good tool joints. Machine well-equipped with bits from 5″ to 30″. All sizes of bailers, new mud pump and new water tank. Rig now operating. Due to ill health will sacrifice for immediate sale. S. J. Catlett, 2408 Main, Woodland, Oklahoma. Phone 797 J.

FOR SALE: New 55 Speed Star mounted on 1½ ton 1951 Dodge truck. All in perfect condition. L. J. Kessler, Troy, Missouri. Phone 349 J.

FOR SALE: Ferguson drilling machine, truck-mounted with cable; John Deere motor. Fair condition. Price $400. Ervin Halverson, Rake, Iowa.

FOR SALE: No. 33 Armstrong drilling machine with Allis-Chalmers motor; 600′ of ¾″ drill line and 600′ of ⅞″ sand line. Mounted on 1945 Ford cab-over-engine truck with new motor. All in good condition. Price $2,000. Nelson Brothers, Decorah, Iowa.

FOR SALE: Side-opening swivel socket; set of 4¼″ drilling jars; 4″ x 13′ drill stem; combination socket for 5″ hole and for 8″ hole; all tools have 2 x 3 API joints. Also offer a late model drilling machine that swings 2,500 pounds of tools. Mitchhart Brothers, Sycamore, Ohio.

WANT TO BUY: Drilling machine that will drill from 1,000 to 1,600 feet deep and possibly second machine for 600 to 1,000-ft. holes. Give complete description in letter, list of tools, where located and the price. Herbert Morrison, Vinton, Ohio.

FOR SALE: New Bucyrus-Erie tools, never used. Two 8″ bits, $125; drill jars, 4¾″, 7″ stroke, $195; wire-rope, swivel sock with Mandrel, $67; 4″ x 12′ drill stem, $115; all with 2¼ x 3¼ joints. Also set of 3½″ claw-end tool wrenches. C. K. Schmudlach, Fredricksburg, Iowa.

DRILLERS WANTED: Two good drillers for work vicinity of Stillwater. Mantyla Well Company, Stillwater, Minnesota. Phone Cottage Grove 2311.

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FOR SALE: Bucyrus-Erie 21-W drill, truck-mounted; in working order, ready to go; 2 x 3-7 API tool joints. Price $3,500. Oasis Drilling Contractors, Waukesha, Wisconsin. Phone Liberty 7-3514.

FOR SALE: No. 45 Armstrong, all-steel drill; 39′ mast with B-E top; power hoist; with cables; with or without tools; Le Roi engine. Good condition. Also 1952 model No. 42 cyclone drill on 2-ton 1945 Dodge truck with new tires and motor. Machine has 36′ mast, power hoist, nearly-new sand and drill lines; with or without 4″ to 10″ tools. Selling because need larger equipment. L. J. Watson, 155th & Western Avenue, Route 1, Harvey, Illinois. Phone 951-R.

FOR SALE: Established well business, including Howell No. 60 drilling machine, repair rig, small inventory; home and 6 lots. Reasonably priced. Loren Blume, Box 101, Belle Plaine, Minnesota. Phone 269.

FOR SALE: Deep-well, turbine pumps, reconditioned and guaranteed; in stock. Capacities 100 to 1,500 gpm; 80′ to 400′ TDH; 10 to 40 HP. Reasonably priced. Geo. L. Smith, 6450 W. River Parkway, Milwaukee 13, Wisconsin.

WANT TO BUY: Good used drilling machine with or without tools. William O. Stout, Route 1, Xenia, Ohio.

DRILLERS WANTED: Cable-tool and rotary for water wells in Turkey; with satisfactory qualifications and experience to complete jobs without supervision. Send application giving brief data on identity, biography, experience, credentials and recent picture. Ilbank-Temel Ltd., P. O. Box 318, Galata, Istanbul, Turkey.

WANT TO BUY: Bucyrus-Erie 22 W, truck mounted, with or without tools. Bihn's Well Drilling, Walbridge, Ohio. Phone Toledo, Lenox 6949, after 6 P.M.

WANT TO BUY: Two Failing 1500-S drilling machines, skid-mounted; complete with tools for 700-foot holes 8″ to 18″ diameter. Other similar machines will be considered. Also, spare 6 x 6 mud pump. Box E A G c/o Edward E. Johnson, Inc., 315 North Pierce Street, St. Paul 4, Minnesota.

FOR SALE: Franks rotary drill in excellent condition; with 4 x 5 Gardner-Denver pump, 500 feet 2⅜″ drill pipe, 4″ to 9″ rock bits, fish-tail bits of various sizes. Mounted on 1941 Ford truck with new motor and tires. Bob Croy, Auburn, Indiana. Phone 256.

FOR SALE: Bucyrus-Erie 21-W with cable and tool guide, for truck mounting; price $1,775. Bucyrus-Erie 21-W with cable and tool guide, mounted on 1½-ton Dodge truck, 1940 model, 4-wheel drive; price $1,975. Both machines well-painted and in good repair, all bearings tight, and drilling wells now. Prices f.o.b. Eugene, Oregon. Casey Jones Well Drilling Co., Route 2, Box 695, Creswell, Oregon.

FOR SALE: Complete set of used tools for 5″ and 6″ holes, 1⅝ x 2⅝ - 7 API joints. Bailer, tool wrenches, drive clamps, bits, all at half price. Casey Jones Well Drilling Co., Route 2, Box 695, Creswell, Oregon.

FOR SALE: All-steel 35 Cyclone drill, 1949 model with friction-clutch-controlled cathead; mounted on 1938 Ford truck. Includes ⅝″ drilling line and 5/16″ sand line. Machine in A-1 condition. Price $1,700. Erwin M. Johnson, Hawley, Minnesota.

WANT TO BUY: Bucyrus-Erie 22-W or 20-W machine with or without 4″ tools. J. Reinarts, 1020 Valley St., Minot, North Dakota.

FOR SALE: Rebuilt 3½ Keystone well drill, trailer-mounted, with International unit

and starter. Nearly new cables, 500 feet ⅝" and 400 feet ⅜". Machine working near home office. Priced to sell. Briggs Well Drilling, Route 2, Advance, Missouri.

FOR SALE: Loomis Clipper No. 1½, wood frame and mast for manila line. Mounted on Chevrolet cab-over-engine truck. All in good operating condition. In use up to time of trade-in on 4" and 6" wells. Price $1,200, without tools or line. Box L M, c/o Edward E. Johnson, Inc., 315 North Pierce, St. Paul 4, Minnesota.

FOR SALE: Winter Weiss reverse circulation rotary drill, almost new, 1954 model; on semi-trailer with 1954 Ford F-600 tractor. Buda 6DT 317 diesel power unit, 90 HP, 6" pump, 100' drill pipe, 18" bit, 27" bit and complete set spare parts. Drilled only 40 wells. Box L B c/o Edward E. Johnson, Inc., 315 North Pierce, St. Paul 4, Minnesota.

FOR SALE: New 55 Speed Star drill mounted on 1½ ton 1949 Studebaker truck. Includes set 4" tools, 350' of drill cable and sand line, all new; and many used tools. Machine bought in August this year before price advance. Will sell at old price because health does not permit me to operate. Bert C. Kinnaman, Route 5, Noblesville, Indiana (Phone 4 F 12, Fortville).

FOR SALE: Twelve-inch Deming turbine pump, with two 10' column sections, rated at 1,400 gpm at 80' head; driven by 40 HP, 3-phase motor, 1,750 rpm, 220 over 440 volts. In good condition — located at Foley, Florida. E. J. Whitcher, Buckeye Cellulose Corporation, P. O. Box 599, Cincinnati 1, Ohio.

POSITION WANTED: Sober, hardworking, married, water-well driller. Careful and able to run any rig without supervision. Willing to work any place at good wages. Now working for French group of drilling companies on Indian irrigation project. Malcolm L. Gernon, 33/28 Patel-Nagar-East, New Delhi, India.

FOR SALE: Custom-built rotary drill with about 500 feet 2⅞" drill pipe; 4½ x 6 Gardner-Denver pump driven by V-8 Ford motor; draw works and rotary table driven by V-8 Ford motor. Price and other details on request. E. C. Baker & Sons, Sigel, Illinois.

FOR SALE: Bucyrus-Erie 29-T drilling machine with Caterpillar diesel engine, including tools. Excellent condition. Box H M c/o Edward E. Johnson, Inc., 315 North Pierce, St. Paul 4, Minnesota.

FOR SALE: 1953 Bucyrus-Erie 20W mounted on 1½ ton 1935 Ford truck; has catheads and casing reel, complete string of tools with 2 x 3 joints. Includes 5" to 10" bits, 300 feet ⅝" drill line, 500 feet ⅜ sand line. Price $4,150. Skinner Brothers, R. F. D. 5, Box 80, Chillicothe, Ohio.

WANT TO HIRE: Responsible young men with some drilling experience, to learn to operate cable or rotary drilling equipment, or install and repair all types of deep well pumps, or operate machine shop, cutting tool joints, and operating machine bit dresser, steady employment. D. E. Edwards, West Branch, Iowa.

WANT TO BUY: Failing 1500 or equal rotary drill equipment to drill 4" to 6" holes to 800'. D. E. Edwards, West Branch, Iowa.

WANT TO HIRE: Experienced, reliable driller for general water well drilling, including hard and soft rock and screen work. Stewart Brothers, Box 976, Schenectady, N. Y.

FOR SALE: 55 Speed Star drill, serial No. 9658, with catheads, casing reel and starter. Mounted on good 1949 Studebaker truck with good tires. Machine in excellent condition. Price $3,750. Eugene Glidden, Lewisville, Indiana. Phone 2405.

FOR SALE: No. 33 Bucyrus-Armstrong well drilling machine with power derrick hoist. Mounted on 1947 International truck. Good condition. Box W B S, c/o Edward E. Johnson, Inc., 315 North Pierce, St. Paul 4, Minnesota.

WANT TO BUY: Rotary drill capable of 2,000-ft. depth; also drill pipe and tools. Will trade Keystone drill with tools and 1,000 feet of line. H. A. Steiner, Oreana, Idaho.

FOR SALE: Bucyrus-Erie 22-T blast-hole drill on cat tracks; Buda engine with starter. Includes 300' of ¾" drill cable and ⅜" sand line; 4¾" x 22' stem with swivel socket; solid-type jar bumper; tool wrenches, 3½" square No. 2; chain tightener. Trailer to haul drill with 8.25 x 20, 10-ply tires, vacuum-hydraulic brakes. H. Landgraf, 560 South Grandview, Dubuque, Iowa. Phone 3-1233.

POSITION WANTED: Young, qualified driller, 33 years old, married. Ten years experience on cable tool and rotary machines. Capable of working without supervision. Want job with any good firm. At present working in irrigation department. SAINI c/o Edward E. Johnson, Inc., 315 North Pierce, St. Paul 4, Minnesota.

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Merry Christmas!
This is the joyful greeting
we send to our customers
around the world.

Your confidence in us
has been a constant
challenge and a
friendly reassurance.

When we look back at the progress
we have enjoyed over the year,
we know that in large
measure you have made it
possible and for this
we are truly grateful.

At this most wonderful of all
seasons we look ahead to
another year of
pleasant association with you.

May your Christmas be bright
and may the New Year bring
you good things
in abundance.

Holiday Greetings

EDWARD E. JOHNSON, Inc.